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MEASUREMENTS OF POLARIZATION AND OF BRIGHTNESS TEMPERATURE DISTRIBUTION OF VENUS IN THE 10.6 cm WAVE

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MEASUREMENTS OF POLARIZATION AND OF BRIGHTNESS TEMPERATURE DISTRIBUTION OF VENUS IN IN THE 10.6 cm WAVE *

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SUMMARY

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This work is the continuation in a broader fashion of the research conducted in 1962 at CALTECH radioastronomical observatory which consisted in experimental measurements of brightness distribution along Venus' disk in nonpolarized radiation [1]. This pursuit took place near the 1964 lower conjunction and included polarization measurements.

Author

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*   *

1.- One of the basic questions of Venus' physics, the solution of which determining the choice between the "cold" and "hot" atmosphere models and, consequently , the planet's surface temperature, is that of the nature of the layer responsible for the radio emission in the 3 to 20 cm wave band. A decisive experiment for the choice of one of these models and the elimination of the indicated ambiguity may be the the detection of differential polarization in the emission of various areas of the visible planet's disk. The high resolution, required for conducting such measurements of Venus, was achieved in the interefrometer of the Owens Valley radioastronomical station of the California Institute of Technology, on which experimental measurements of brightness distribution along Venus' disk in nonpolarized radiation were conducted in 1962 [1]. This research was pursued by us according to a

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* IZMERENIYA POLYARIZATSII I RASPREDELENIYA YARKOSTNOY TEMPERATURY VENERY NA VOLNE 10.6 cm.

significantly broader program, including polarization measurements.

2. - Measurements were conducted in May - July 1964 in the 10.6 cm wavelength, with bases from 600 to 6 500 λ and different polarization.

The visibility function was measured alongside with its dependence on the polarization of the received radiation and the orientation of interferemoter's base relative to Venus; measured also were the intensity and the polarization of the integral planet's radio emission.

3.- The results of measurement of differential polarization, plotted in Fig. 1 in the form of difference of the visibility functions for polarizations, perpendicular ($F_\perp$) and parallel ($F_\parallel$) to the effective base of the interferometer, as a function of the interferometer's resolution β, show the difference between $F_\perp$ and $F_\parallel$, substantially exceeding the measurement errors, and establish specifically the fact of the presence of differential polarization of Venus' radio emission. Consequently, the main part of Venus' radio emission in the 10 cm band is conditioned by the continuum. The surface of the planet is apparently such a medium.

4. - The value of differential polarization, and consequently, the differences $F_\perp - F_\parallel$, depend on the dielectric constant ε of the emitting medium. This dependence, computed for a smooth sphere and brought out also in Fig. 1, provides the possibility of determining the value of ε from the results of measurements.

The best agreement of experimental data with the calculation, determined by the method of least squares, corresponds to

$$\varepsilon = 2{,}2 \pm 0{,}2.$$

The accounting of the effect of surface roughness, effected according to data of radar measurements in the neighboring wave of 12.5 cm [2], increases the value of the dielectric constant of Venus' surface to $\varepsilon = 2{,}5$.

5. - The analysis of the results of measurements of the dependence of visibility functions on the orientation of the base of the interferometer and on the hour angle, and also on the polarization of planet's integral radio emission, brought to light the asymmetry in the distribution

of brightness temperature along the planet's disk *. In one of the directions the brightness temperature at planet's edge is by 25 — 30 percent less than in the orthogonal direction.

6. - The orientation of Venus' pole was determined in the assumption, that the regions of lowered brightness temperature are the polar regions of the planet.

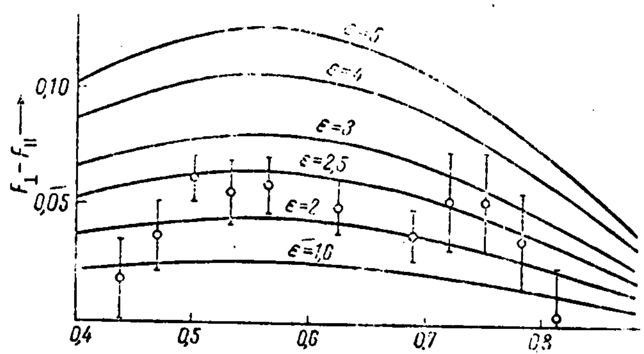

Fig. 1

According to polarization measurements, the coordinates of Venus' pole in the ecliptic system of coordinates are

$$\lambda = 213°, \quad \beta = 64°,$$

which corresponds to equatorial coordinates

$$\alpha = 15^h50^m, \quad \delta = 47°.$$

According to the results of measurements, the dependences of the visibility function on the hour angle

which corresponds to
$$\lambda = 192°, \quad \beta = 74°,$$
$$\alpha = 15^h50^m, \quad \delta = 59°.$$

7. - The analysis of the value of the first maximum and of the zero position of the visibility function allowed also to estimate the distribution of brightness temperature in the equatorial direction and the diameter of the radioemitting region. There is in the equatorial region a tendency to a small increase in brightness temperature near the terminator relative to anthelion point. The diameter of the region responsible for Venus'

* The polarization of integral radioemission of the planet with asymmetry in the distribution of brightness temperature was predicted by Troitskiy [3]

radio emission in the 10 cm wave band, is by 0.7 ± 0.9 percent less than the ephemerid one and constitutes

$$d = 12\,114 \pm 110 \text{ km}.$$

8.- The detected "darkening" of poles can be interpreted :

a) by latitude decrease of the true surface temperature. In this case the surface temperature in polar regions would constitute $\sim 450^\circ$ K.

b) by the presence in near-polar regions of Venus of an absorbing atmosphere (ionosphere), colder than the surface, and with an optical thickness of ~ 0.4.

A more detailed paper a out the results of the work will be published in the Astronomical Journal (Astronomicheskiy Zhurnal).

The authors express their deep gratitude to the Director of the Owens Valley Radioastronomical Observatory, Professor G. Stanley, having in every way cooperated in the conducting of the present work.

**** THE END ****

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